# THE INSTITUTE SPOKESMAN

PUBLISHED BY THE
NATIONAL LUBRICATING GREASE INSTITUTE

VOLUME XI • NUMBER 1 • APRIL 1947

## March Issue Makes History

From the standpoint of size, volume of advertising, and special features, last month's special Tenth Anniversary March issue made history!

Two new features made their initial appearance; a "President's Column" in which President H. P. Hobart brought his first message to the readers of "The Institute Spokesman." Adding proof of his journalistic ability to his many other accomplishments, President Hobart outlines the early history of the N. L. G. I., its organization, progress through the years, purposes and activities. It certainly provided a very comprehensive yet concise statement about the Institute, and if anybody should ask you a question about the National Lubricating Grease Institute, it is dollars to doughnuts, you can find the answer in this first "President's Column" in the March issue. Each issue of "The Spokesman" from now on will have this new feature. Readers of "The Spokesman" can look forward each month to a fine message from the N. L. G. I. President.

The second feature was a report of the activities of the Technical Committee calling attention to the latest bulletin duplicated and distributed which reports the discussion that took place at the symposium on the "Pumpability of Grease and Delivery Characteristics of Dispensing Equipment" held on the third day of the Fourteenth Annual N. L. G. I. Convention in Chicago last October. From time to time as there are activities of the Technical Committee to report this feature will be continued.

It took twenty-four pages to carry the advertising, technical articles and news material of this March issue. At that we eliminated or rather held over to this issue several articles that might have been included. The issue was just six times larger than the original "Spokesman" that made its appearance with the March issue ten years ago.

From the standpoint of number as well as volume of advertising the March issue sets a very fine record. Friends of the Institute and "The Spokesman" used advertising space liberally to carry their message of greetings and congratulations as well as to advertise their products to the readers of "The Spokesman."

*The* INSTITUTE SPOKESMAN

*Published monthly by*
THE NATIONAL LUBRICATING GREASE INSTITUTE
CARL E. BOLTE ..... *Editor*
4638 Millcreek Parkway
Kansas City 2, Mo.

OFFICERS

*President*: H. P. HOBART, Gulf Oil Company, Gulf Building, Pittsburgh, Pa.
*Vice-President*: J. R. CORBETT, Cato Oil and Grease Company, 1808 East Ninth, P. O. 172, Oklahoma City, Okla.
*Treasurer*: E. V. MONCRIEFF, Swan-Finch Oil Company, Rm. 1605, R. C. A. Building, New York 20, N. Y.
*Executive Secretary*: CARL E. BOLTE, 4638 Millcreek Parkway, Kansas City 2, Missouri.
*Recording Secretary*: GEO. W. MILLER, Battenfeld Oil and Grease Co. of New York, 498 Winspear Ave., Buffalo, N. Y.

DIRECTORS

J. R. BATTENFELD, Battenfeld Grease and Oil Corp., 3148 Roanoke Rd., Kansas City, Missouri.
M. R. BOWER, Standard Oil Co. of Ohio, Midland Building, Cleveland 15, Ohio.
W. G. CLARK, Pure Oil Company, 35 East Wacker Dr., Chicago 1, Illinois.
HOWARD COOPER, Sinclair Refining Company, 630 Fifth Ave., New York, N. Y.
J. R. CORBETT, Cato Oil and Grease Company, 1808 East Ninth St., P.O. 172, Oklahoma City, Oklahoma:
C. W. GEORGI, Enterprise Oil Company, 164 Chandler, Buffalo 7, N. Y.
H. P. HOBART, Gulf Oil Company, Gulf Building, Pittsburgh, Pa.
C. B. KARNS, Standard Oil Co. of Pennsylvania, 34th and Smallman, Pittsburgh, Pa.
F. C. KERNS, The Texas Company, 135 East 42nd St., New York 20, N. Y.
H. A. MAYOR, Southwest Grease and Oil Co., 220 West Waterman, Wichita, Kansas.
G. E. MERKLE, Fiske Bros. Refining Company, 129 Lockwood Ave., Newark 5, N. J.
E. V. MONCRIEFF, Swan-Finch Oil Company, Rm. 1605, R.C.A. Building, New York 20, New York.
G. L. NEELY, Standard Oil Co. of California, San Francisco 20, California.
W. H. OLDACRE, D. A. Stuart Oil Co., Ltd., 2727 South Troy, Chicago 23, Illinois.
W. H. SAUNDERS, JR., International Lubricant Corp., New Orleans, Louisiana.
B. G. SYMON, Shell Oil Company, Inc., 50 West 50th, New York 20, N. Y.
B. C. VOSHELL, Socony-Vacuum Oil Co., Inc., 26 Broadway, New York 4, New York.
L. C. WELCH, Standard Oil Company of Indiana, 910 South Michigan, Chicago, Illinois.

DOPP
*positively-scraped*
GREASE KETTLES
*and*
PRESSURE MIXERS

BUFLOVAK EQUIPMENT DIVISION
of Blaw-Knox Company
1625 Fillmore Ave. Buffalo 11, N. Y.

IMPROVED
Automotive Lubricants
Greases and Cutting Fluids

PENOLA INC.
26 BROADWAY, NEW YORK 4, N.Y.

CORRECT
LUBRICATION
*since* **1866**

**SOCONY-VACUUM
OIL COMPANY, INC.**

26 BROADWAY NEW YORK, N. Y.

# *New Members . . . Welcome*

It is a pleasure to welcome five new members of the N. L. G. I. since the February issue of "The Spokesman" last reported on this very important phase of the Institute's activities. This month we greet three Active and two Associate members.

The Western Oil Co., Ltd., Bank of Montreal Building, Moose Jaw, Saskatchewan, Canada which makes the second Active Institute Member from this same city. Mr. G. H. Moore is the Manager.

Also to Active Membership we welcome the Thermoil Lubricants Corp. of Elk City, Oklahoma. Mr. O. O. Funderburg, President, was one of the original partners who organized the Consumers Oil Company in 1935. The business grew until 1938 when a part of the present plant was built and the company added its own lubricating grease manufacturing equipment. In 1941 the Thermoil Lubricants Corp. was formed as Mr. W. W. Blackburn and three associates purchased an interest from Mr. Funderburg's partner. Additional buildings were built, new equipment added and today the company's salesmen cover the states of Oklahoma, Texas, New Mexico, Arizona, Colorado, and Kansas doing a half million dollar business in 1946 on their five leading brands: Penn Bee, Triple XXX, Elk-o-lene, Brama, and Thermoil.

The Nourse Oil Company was established in 1905 by Jack C. Nourse, father of the present president, who bears the same name. Joseph L. Nourse, the other son is now Jobbers Sales Manager. A well known complete line of oils and greases has been sold over a wide territory aided by the familiar and optimistic advertising slogan "Business Is Good." The present Jack Nourse is Chairman of the Oil Men's Club of Kansas City, founded by his father who served as its first chairman. The group will celebrate its 26th anniversary in October.

The Monsanto Chemical Company of St. Louis, Missouri is a new Associate Member. Mr. J. W. Newcombe, Manager Petroleum Chemical Sales in the Organic Chemical Division will represent Monsanto in the Institute.

*Continued on page 7*

**Bat's . . .**

**4-in-1 BARIUM LUBRICATING GREASE**

• **An All-Purpose Automotive Lubricant**
**It does the work of 4**

Efficiently lubricates the chassis, wheel bearings, water pumps, universal joints, etc.

**BATTENFELD GREASE & OIL CORPORATION**

KANSAS CITY, MO. NORTH TONAWANDA, N. Y. MINNEAPOLIS, MINN.

*"Business Is Ingreasing"*

# AN ELECTRON MICROSCOPE STUDY of Lubricating Greases

• B. B. FARRINGTON AND D. H. BIRDSALL
California Research Corporation, Richmond, Calif.

### About the Authors

*Mr. Farrington was born in Alameda, California, and received a B.S. degree from the University of California in 1920. Joining the Research and Development Department of the Standard Oil Company of California immediately after graduation, he has been with this Company and its research subsidiary, the California Research Corporation, ever since.*

*Mr. Farrington has had a wide experience in the field of petroleum research and development, holding many patents on such diverse subjects as nonflammable cleaning fluids, wood preservatives, treating agents and processes for breaking in frictional bearing parts, compounded heavy duty lubricating oils, gear lubricants and greases.*

*The author was the first to demonstrate (in 1936) the fibrous nature of the conventional sodium and calcium soap lubricating greases and the effect of soap fiber length on grease texture.*

*He is now Supervisor of the Lubricants Division of the California Research Corporation and resides in Berkeley, California.*

*Mr. B. B. Farrington delivering this paper before the 14th Annual Convention, Chicago, Illinois—Sept. 30 — Oct. 2, 1947.*

*Dale H. Birdsall was born July 19, 1919 in Galesburg, Illinois and graduated from Knox College with an A.B. in physics in 1941. He spent five years on active duty as an officer in the U. S. Army Signal Corps and Air Corps. During this time he commanded several radar stations along the Northern California Coast and later, as a Captain, commanded a Signal Aircraft Warning Company and an AAF squadron. He joined the California Research Corporation in February 1946 where he has been engaged in research on the fiber structure and flow properties of lubrication greases.*

**EDITOR'S NOTE:**
**The opinions expressed in the following article are those of the author. "The Spokesman" takes no credit and assumes no liability therefor.**

In 1936 one of the writers (1) presented the results of a study of the structure of lubricating greases by means of the microscope with dark field illumination. In that investigation the resolving power of the best available microscopes was only sufficient to discover the fine structure of the soap fibers in sodium soap greases. The magnification was found inadequate to resolve the detailed structure of the soap particles in calcium and aluminum soap greases. Since calcium soap greases form the bulk of grease products marketed, a considerable field of research was blocked by the limitation of the tools then available. The evidence indicated, however, that all greases owe their peculiar plastic properties to the fiber structure of the soap particles which permeate and support the mineral oil component.

Later Lawrence (2) and Gallay, Puddington and Tapp (3) published micrographs of sodium soap gels and greases taken with polarized light at low magnifications (74 to 200x).

The invention of a powerful new tool, the electron microscope, has allowed us to obtain detailed pictures of the soap fibers characteristic of most of the types of commercial lubricating grease, since the useful magnification is up to 40 times that of the light microscope on the same material.

The micrographs which are here presented were, with one exception, taken with the RCA Model B electron microscope owned by the University of California. One of the pictures, Fig. 7, was taken at the Camden Laboratory of RCA Victor with the Model EMU microscope. A complete description of the Model B equipment can be found in the book by Zworykin et al (4).

### Operation of Electron Microscope

An electron beam current of from 100 to 200 micro-amperes with an accelerating potential of 55,000 volts was used for viewing specimens optically as well as for photographing. Prior to taking photographs the illumination was reduced with the condenser control until exposures of from 5 to 8 seconds gave satisfactory results on lantern slide medium plates.

### Preparation of Grease Samples

The preparation of the grease samples for observation required considerable study, chiefly because only extremely thin films of grease are transparent enough to examine with the electron microscope. Attempts were made to obtain satisfactory specimens by several methods, including diluting the grease with volatile solvents, kerosene, and medicinal white oils (for heavy greases). The most reliable method found consisted of simply smearing the grease out on a glass slide into a thin film and then transferring a minute amount to a previously prepared collodion film by means of a tiny glass rod. The collodion film (transparent to electrons) was made by the standard electron microscope technique; i.e., a collodion solution was deposited on water, the small supporting screen dropped on to the collodion film, the two picked up on a glass slide, allowed to dry, and the tiny wire screen with the adhering collodion film cut or torn from the bulk of the deposited film.

In many cases it was found advantageous to wash the oil from the prepared grease specimen by allowing a drop or two of petroleum ether to fall upon the collodion—supported grease smear held at an angle. The soap fibers were thus freed from obscuring oil. Micrographs were always taken of the unwashed grease for comparison to determine if swelling or distortion of the soap fibers occurred.

### Grease Micrographs

The following micrographs illustrate the various types of soap fiber encoun-

1. Farrington, B. B. and Davis, W. N., Ind. Eng. Chem. 28, 414-6 (1936).
2. Lawrence, A. C. S., Jour. Inst. Pet. Tech. 24, 207 (1938).
3. Gallay, W., Puddington, I. E., and Tapp, J. S., Can. J. Res. 22, 66 (1944).
4. Zworykin, Morton, Rombey, Hillier and Vance, Electron Optics and the Electron Microscope, Wiley and Sons, N. Y. 1945.
5. Williams, R. C. and Wyckoff, R. W. G., J. Appl. Phys. 17, 23 (1946).

tered in commercial types of lubricating grease. Original magnifications were 4,000 x and 8,000 x with the exception of Figure 7 which was taken at 13,000 x. Enlargements in the final prints from these magnifications are photographic. The soap fibers shown are, of course, not pure chemical compounds but metal salts of the mixed fatty acids of commerce. The pertinent data characterizing the various greases shown are given in Table 1.

Fig. 1 shows a medium fiber sodium soap grease in which the ribbon-like character of the sodium soap fibers is clearly demonstrated, the twist in the large fiber in the upper right corner being noteworthy.

*Figure 1*
*Sodium Soap Grease (No. 1)*
*Medium Fiber*
*8,000 x*

In Fig. 2 the grease shown in the previous picture has been milled with a small amount of additional oil. It will be seen that the ribbon-like soap fibers have been chopped up with little axial splitting.

*Figure 2*
*Sodium Soap Grease (No. 2)*
*Short Fiber*
*9,000 x*

Figs. 3, 4 and 5 show sodium soap brick greases, mixed with white oil to thin out the fiber concentration, and washed on the microscope specimen film with petroleum ether to remove all mineral oil. The heterogeneity of the soap fibers is apparent. Fig 4, at higher magnification, shows a wealth of small background fibers. In Fig. 5 the soap fibers tend to be curved or sinuous.

*Continued on page 8*

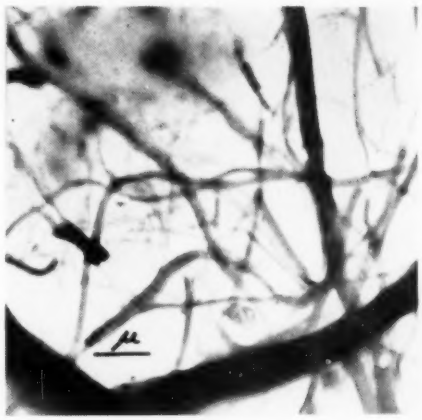


*Figure 3*
*Sodium Soap Brick Grease (No. 3)*
*Thinned with White Oil, Pet. Ether washed*
*8,000 x*

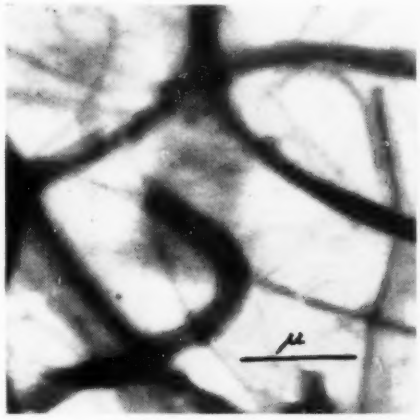


*Figure 4*
*Sodium Soap Brick Grease (No. 3)*
*Thinned with White Oil, Pet. Ether washed*
*16,400 x*

**TABLE 1**

| Grease No. | ASTM Worked Pen. | Soap Type | Soap % | Oil % | Oil Vis/100 SSU | Oil Vis/210 SSU | Oil V. I. | Approx. Fiber Dimensions (μ)* Length | Width | Thickness |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 260 | Sodium | 25 | 75 | 482 | 60.9 | 85 | 40-50 | 0.2-0.5 | 0.06 |
| 2 | 310 | Sodium | 20 | 80 | 482 | 60.9 | 85 | 1.2-3.4 | 0.1-0.4 | 0.06 |
| 3 | 38 (Unworked) | Sodium | 27 | 73 | 2700 | 104 | 10 | Heterogeneous | | |
| 4 | 55 (Unworked) | Sodium | 33 | 67 | 150 | 43.2 | 101 | Heterogeneous | | |
| 5 | 320 | Calcium | 11 | 89 | 200 | 42.8 | 5 | 0.5-1.0 | 0.01-0.04 | |
| 6 | 285 | Calcium | 12 | 88 | 200 | 42.8 | 5 | 1.0-1.5 | 0.05 | 0.015 (Stretched) |
| 7 | 365 | Calcium | 6 | 94 | 1890 | 90 | 15 | 0.8-1.8 | 0.04 | |
| 8 | 330 | Barium | 14 | 86 | 507 | 55.1 | 36 | 1.3-3.0 | 0.01-0.04 | |
| 9 | 285 | Strontium | 32 | 68 | 1910 | 127 | 96 | 15+ | 0.07-0.12 | 0.02 |
| 10 | 320 | Strontium | 21 | 79 | 118 | 39.4 | 32 | Large 1.8-2.4 | 0.12-0.16 | |
| | | | | | | | | Small 0.2-0.5 | 0.01 | |
| 11 | 315 | Lithium | 15 | 85 | 58.9 | 34.2 | 50 | 0.6-1.2 | 0.01 | |
| 12 | 150 | Lithium | 20 | 80 | 463 | 51.6 | 10 | 0.2-0.6 | 0.03 | |
| 13 | 340 | Aluminum | 12 | 88 | 391 | 56.7 | 92 | | | |

*1μ=.001 mm.

# President's Column...

## N. L. G. I. REPRESENTS THE GREASE INDUSTRY

H. P. Hobart, President
N. L. G. I.

In its initial article last month this column gave a brief history of N. L. G. I., briefly explained the objectives, and invited others interested to join with us in carrying on the work of the Institute.

Some idea of the extent to which our present membership represents the grease manufacturing industry in the United States may be of interest to our members and prospective members at this time, as well as to industry in general.

The N. L. G. I. is primarily a technical society, seeking to promote the interest of the consumer as well as that of the industry, and does not fill the role of a trade association. Accordingly, it has no recent accurate figures covering the total quantity of grease manufactured in the United States, but it has been estimated that the 63 grease manufacturers which presently comprise the Institute's Active Membership manufacture approximately 90 per cent, by weight, of the lubricating grease produced yearly in this country.

Of the 63 grease manufacturers 35 devote their production primarily to grease, and 28 manufacture both lubricating oil and grease.

The 35 grease manufacturers include all but a few of the larger companies devoting their production primarily to grease, and the Institute extends a very cordial invitation to those who are not now members to join with us.

The 28 members who manufacture both lubricating oil and grease include most of the larger integrated oil companies in this country. In this group, too, the Institute extends a very cordial invitation to such companies who are not now members to join the Institute.

Geographically, grease is manufactured in 16 of the 48 States by our present members, and distribution and sales include all 48 States.

The present Active Membership is distributed as follows:

| | | | |
|---|---|---|---|
| New York | 11 | Indiana | 1 |
| Illinois | 7 | Georgia | 1 |
| Pennsylvania | 6 | Louisiana | |
| New Jersey | 6 | Texas | |
| Ohio | 5 | Iowa | |
| California | 4 | Minnesota | |
| Kansas | 3 | Nebraska | |
| Missouri | 3 | Canada | |
| Oklahoma | 3 | Australia | |

From the standpoint of lubricating grease production it is apparent, therefore, that N. L. G. I. is in position to reflect the views of the industry on technical problems of manufacture, application and use of industrial and automotive lubricating greases.

The Institute is proud to have 24 Associate Members which, while not manufacturers of grease, are directly interested

ARO
AUTOMOTIVE, INDUSTRIAL
LUBRICATING
EQUIPMENT
"We Invite Comparison"
THE ARO EQUIPMENT CORP.
BRYAN, OHIO

INTERNATIONAL LUBRICANT CORPORATION
NEW ORLEANS, U. S. A.
INTERNATIONAL LUBRICATION
QUALITY I SERVICE
L C
AROUND THE WORLD
MANUFACTURERS AND EXPORTERS OF LUBRICANTS

in the lubricating grease industry by reason of making equipment for same or being suppliers of products used in the manufacture of grease. Through close cooperation with these suppliers many technical problems of supply, specifications of ingredients, use and performance of equipment can be more easily worked out to the benefit of the consumer. The flow characteristics of various types of greases and their pumpability performance in various designs of grease pumps and dispenser equipment are among the problems which have been discussed.

The N. L. G. I. Grease Consistency Numbers have been widely adopted in this country as a means of assisting consumers to specify desired consistencies.

Our present Associate Membership includes:

7 Manufacturers of grease dispensing equipment.
6 Suppliers of ingredients for grease manufacture.
5 Manufacturers of containers or packages for grease.
4 Technical and Research.
2 Manufacturers of grease-making equipment.

N. L. G. I. extends a very cordial invitation to join the Institute to all concerns interested in the grease industry and desiring to cooperate in the work of the Institute to bring about better service to the grease consumer.

## New Members-Welcome

Continued from page 3

In addition to its greatly diversified activities in fine chemicals, plastics, phosphate, and recently acquired ply wood adhesives on the Pacific Coast, Monsanto serves the petroleum industry through its Organic Chemical Division by manufacturing a complete line of oil additives including pour point depressants, various corrosion inhibitors and extreme pressure additives for gear lubricants, all particularly designed to aid refiners and compounders to improve their high quality lubricating oils and gear lubricants. Some of the other chemicals sold to the oil industry include water treating compounds, phosphates for oil well drilling muds, and insecticides.

The second Associate Member is the Lincoln Engineering Company of St. Louis, Mr. Foster Holmes, Vice-President and Treasurer, will be the contact between his company and the Institute.

The Lincoln Engineering Company are pioneer builders of engineered lubricating equipment. Backed by twenty-five years of experience in the field, their lubricating equipment is sold internationally under a plan of selective distribution through automotive and mill supply wholesalers. The company manufactures a complete line of hand, air and electric operated dispensing equipment including automatic centralized systems, together with a full series of high pressure and volume type lubrication fittings.

A genuine and cordial welcome is extended to all five of these firms.

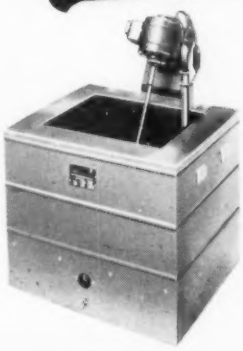

**Special Delivery to Every Bearing!**

Farval—the Dualine System with the Positive Piston Displacement Valve — that has but 2 Moving Parts—is Fully Adjustable—and with a Telltale at each bearing to show the job is done.

THE FARVAL CORPORATION
CLEVELAND 4, OHIO

**FARVAL**
CENTRALIZED SYSTEMS OF LUBRICATION

**New "PRECISION" Utility BATHS**



Temperature range room to 200° C., accuracy plus or minus 1°. Designed specifically for utility laboratory requirements that demand a compact bath with good sized working chamber, accurate, easy setting controls, which is capable of filling the requirements for many A.S.T.M. Tests.

**CONSTRUCTION** — Outer jacket is heavy, galvannealed iron, finished in high aluminum. Interior is stainless steel.

**HEATING ELEMENT** — Steel sheathed immersion heater, capable of bringing bath up to temperature quickly from a cold start.

**TEMPERATURE CONTROL AND HEATING MEDIUM** — Hydraulic thermostat utilizes a liquid expansion coil which provides uniform, constant temperature. Heating medium is oil, bath capacity 19 gallons.

**INSULATION** — Three inches of glass wool, insulates bath against room temperature fluctuations, reduces wall losses and insures temperature control accuracy and uniformity.

**CIRCULATION** — Ball-bearing, fully enclosed, resilient mounted, motor stirrer designed specifically for continuous duty.

**WORKING CHAMBER** — 18" high x 18" wide x 15" deep provides ample space for support stand with upper and lower shelf which can be furnished.

**ELECTRICAL CHARACTERISTICS** — 115 Volts, 60 Cycles, A. C. 3000 watts. Write for detailed literature, Dept. R.

*See Your Laboratory Supply Dealer*

**Precision Scientific Company**
2737 CORTLAND STREET CHICAGO 47, ILL., U.S.A.
*Scientific Research and Production Control Equipment*

**Swan-Finch Oil Corp.**

RCA Building 201 N. Wells St.
New York 20, N. Y. Chicago 6, Ill.

*Manufacturers*

**Lubricating Oils — Greases**

**Foundry Core Oils**

# AN ELECTRON MICROSCOPE STUDY of Lubricating Greases

Continued from 5

Figs. 6 to 13 are electron micrographs of conventional hydrated calcium soap greases for which the grease specimens were prepared by various techniques. Fig. 6 shows the wavy appearance of the calcium soap fibers as they exist in the grease. It was at first thought that this effect might have been produced by dehydration in the electron microscope but specimens which were left in the microscope for periods up to one hour exhibited no structural change from those photographed immediately after introducing them into the instrument.

In Fig. 7, taken at higher magnification, the calcium soap fibers appear to be stretched and more ribbon-like. Fig. 8, however, is more typical of the calcium soap fibers, the barber pole appearance of the rather stiff-looking fibers being evident.

Figs. 9 and 10 show the same calcium soap grease; in Fig. 10, however, the grease was washed with petroleum ether to free the calcium soap fibers of oil. It is seen that much clearer pictures are obtained in this case with no visible distortion of the soap fibers.

In Figs. 11 to 13, the calcium soap fibers were gold shadowed as described by Williams and Wyckoff (5). The greases were mounted on specimen screens in the manner described previously. The prepared specimens were then placed in a bell jar which was evacuted prior to shadowing. The evaporation source consisted of a V shaped filament of 20 mil tungsten wire. A piece of gold wire was hung from the V and fused to the tungsten by heating electrically in a vacuum.

The specimens to be shadowed were placed at a distance of about 2 cm. from the filament and in such a position that the angle from the specimens to the filament was about 10°. It was found that contrast and detail were improved at sharp shadowing angles. A vacuum of at least 3 microns was necessary for sharp shadows at 2 cm. from the filament.

The actual shadowing operation was of approximately 15 seconds duration at a filament current of 8 to 10 amperes. Properly shadowed specimens had a slight gold tinge which could be observed through the bell jar.

All satisfactory gold-shadowed pictures were of greases from which the base oil had been removed with petroleum ether prior to shadowing. It was found that little was gained from shadowing if the oil phase was left in the grease. This is shown by a comparison of Fig. 11 with Figs. 12 and 13. The twisted rope-like calcium soap fibers show many interesting forms. A study of Figs. 12 and 13 will show fibers having right hand and left hand twists, fibers which have apparently grown through one another (see lower right corner of Fig. 13) and

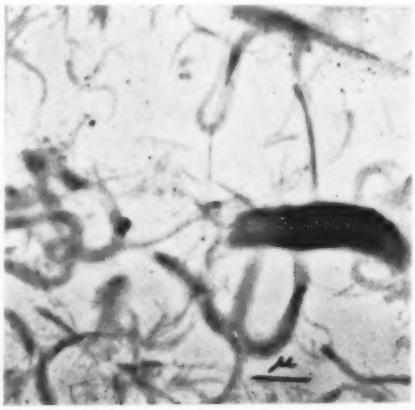


Figure 5
Sodium Soap Brick Grease (No. 4)
Thinned with White Oil, Pet. Ether washed
8,000 x

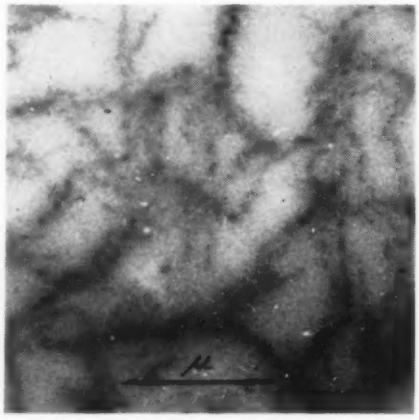


Figure 6
Calcium Soap Grease (No. 5)
Wavy soap fibers
21,000 x

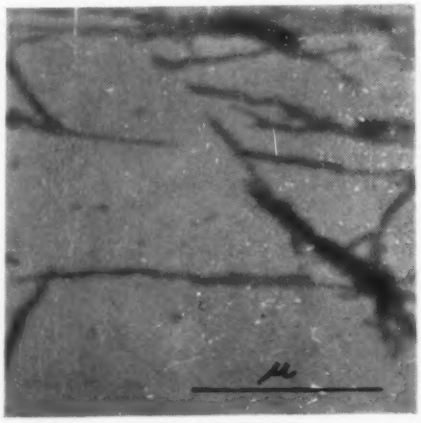


Figure 7
Calcium Soap Grease (No. 6)
Stretched soap fibers
26,000 x

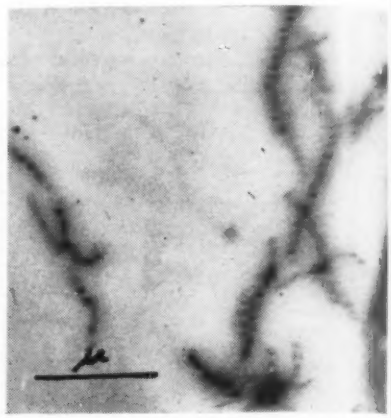


Figure 8
Calcium Soap Grease (No. 6)
Twisted soap fibers
16,400 x

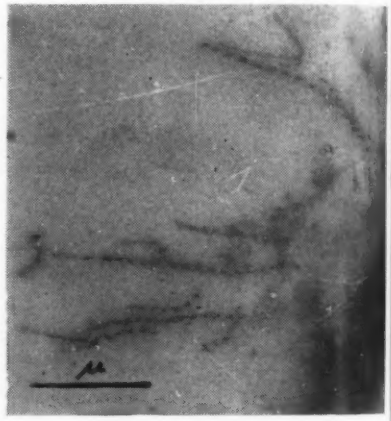


Figure 9
Calcium Soap Grease (No. 7)
Twisted soap fibers
16,400 x

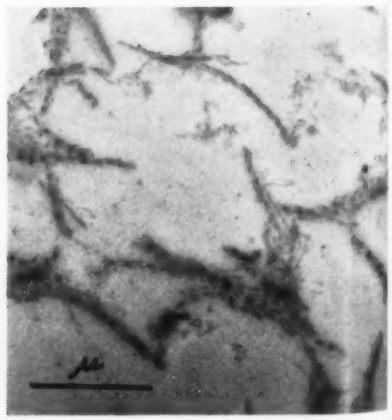


Figure 10
Calcium Soap Grease (No. 7)
Twisted soap fibers, Pet. Ether washed
16,400 x

a few wavy fibers that have unravelled. Calcium soap fibers of the greases examined measure 1.0 to 1.5μ in length, approximately 0.5μ in width and have a "twist period" (frequency of revolution about the long axis) of about 0.1μ. Measurements indicate that shadowing increases the fiber dimensions somewhat, possibly due to gold deposition.

Barium soap fibers are shown in Fig. 14 and two types of strontium soap fibers in Figs. 15 and 16. Whether the filamentous forms of Fig. 15 or the rod-like fibers of Fig. 16 are obtained depends upon variables such as mineral oil type and manufacturing procedure.

The lithium soap fibers shown in Figs. 17 and 18 are needlelike, those in Fig. 18 being about the size and shape of tobacco mosaic virus. Fiber bundles, together with single fibers are seen in Fig. 17.

We have not been successful to date in differentiating the individual soap particles of aluminum soap greases. Typical aluminum soap clumps are shown in Fig. 19. Although at first it was thought that the soap particles consisted of very small fibers, experimental work (in progress) has cast doubt on this view. Further research with the gold shadowing technique will be required to settle this point.

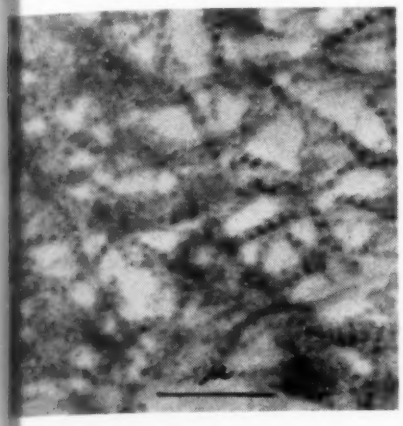


*Figure 11*
*Calcium Soap Grease (No. 5)*
*Gold shadowed*
*16,400 x*

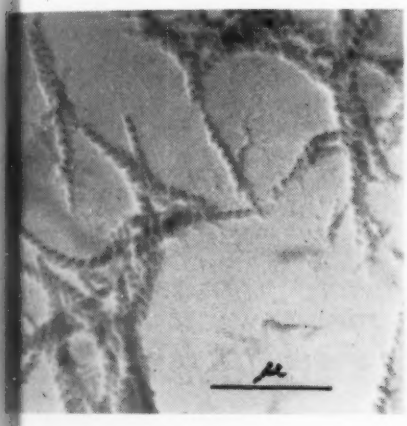


*Figure 12*
*Calcium Soap Grease (No. 5)*
*Pet. Ether washed, gold shadowed*
*16,400 x*

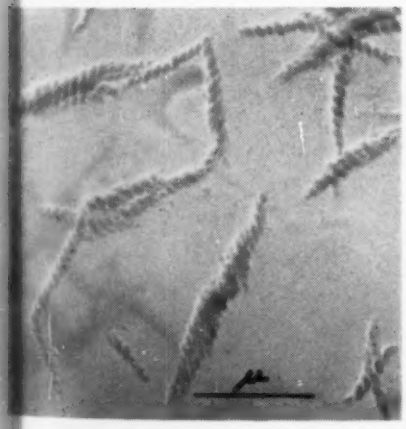


*Figure 13*
*Calcium Soap Grease (No. 5)*
*Pet. Ether washed, gold shadowed*
*16,400 x*

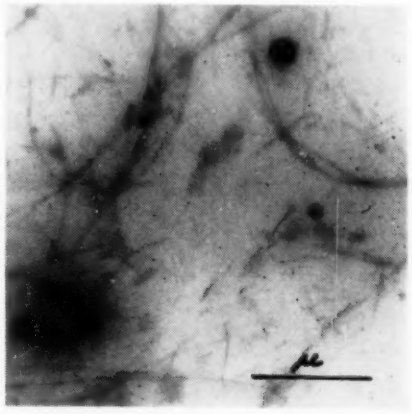


*Figure 14*
*Barium Soap Grease (No. 8)*
*16,400 x*

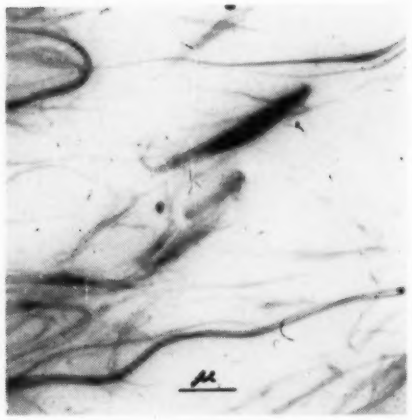


*Figure 15*
*Strontium Soap Grease (No. 9)*
*Filamentous fibers*
*8,000 x*

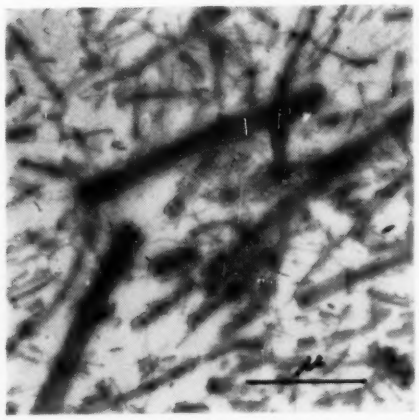


*Figure 16*
*Strontium Soap Grease (No. 10)*
*Rod-like fibers*
*16,400 x*

## Discussion

Although the electron microscope allows us to see before our eyes the soap fibers making up the backbone of most types of lubricating greases, it gives us no direct measure of their physical properties such as melting point and mechanical strength. The stability of these fibers can perhaps best be studied by electron microscope examination of the greases before and after laboratory or service tests. The effect on the fibers of variation in methods of manufacture, raw materials and additives can no doubt be studied with benefit by means of the electron microscope. Correlation of these findings with physical properties of the grease and service performance is the ultimate goal of studies of this kind.

## Conclusions:

1. The higher magnification made possible by the electron microscope has shown that in all soap-type lubricating greases so far examined (with the possible exception of aluminum base greases) the soap particles are fibrous in nature. This applies especially to some lithium and strontium soap grease particles which are invisible to the ordinary light microscope.

2. The soap fibers of the greases examined varied in length from less than 0.2μ (.0002 mm) to 50μ (.05 mm), the length to width ratio being from 10:1 to over 200:1.

3. Soap fibers of conventional hydrated lime soap greases are twisted; all other fibers studied were in the form of rods or ribbons.

## Acknowledgment:

Grateful acknowledgment is made by the authors to Mr. W. E. Rettig, who

Continued on following page

*"Good Oil is essential to good grease"*

**DEEP ROCK**
"G" Cylinder Stock
Dewaxed Bright Stocks
and Neutral Oils

**DEEP ROCK OIL CORPORATION**
55 N. Clark St. Chicago, Ill.

Use MetasapAluminum Stearate Bases for Clear, Transparent Water Insoluble Greases.

•

**METASAP CHEMICAL COMPANY**
HARRISON, NEW JERSEY

**WOOL GREASES**
**(Degras)**
Common — Neutral — Lanolin
*For All Purposes*
Refined by
**N. I. MALMSTROM & CO.**
**BROOKLYN, N. Y.**

**Ship Safely in Barrels made by J&L**
**J&L STEEL BARREL COMPANY**
SUBSIDIARY OF
Jones & Laughlin Steel Corporation
PLANTS
North Kansas City, Mo. - Bayonne, N.J.
Philadelphia, Pa. - New Orleans, (Gretna) La.
Cleveland, Ohio - Port Arthur, Texas

## An Electron Microscope Study Of Lubricating Greases

*Continued from page 9*

took some of the micrographs shown, and to the University of California, Physics Department and the RCA Victor Division of the Radio Corporation of America for the use of their equipment.

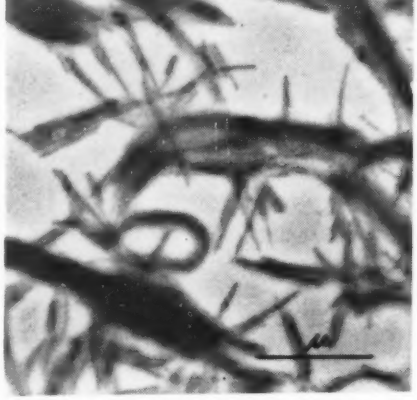


*Figure 17*
*Lithium Soap Grease (No. 11)*
*Fiber bundles*
*16,400 x*

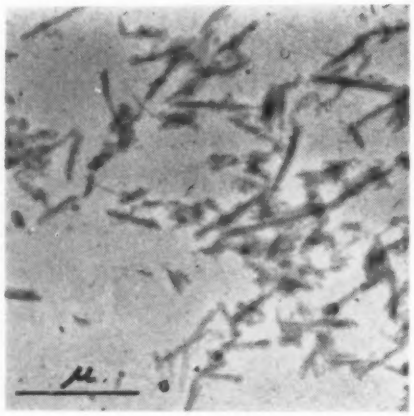


*Figure 18*
*Lithium Soap Grease (No. 12)*
*Needle-like fibers*
*16,400 x*

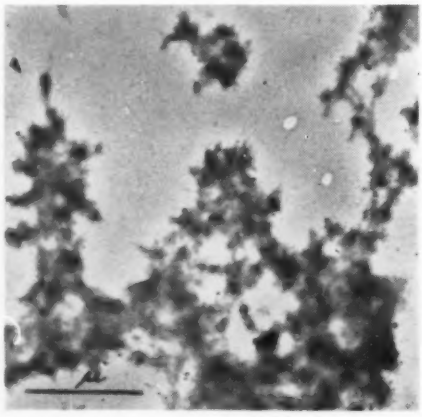


*Figure 19*
*Aluminum Soap Grease (No. 13)*
*16,400 x*

**A COMPLETE LINE OF HIGH QUALITY GREASES FOR AUTOMOTIVE AND INDUSTRIAL APPLICATIONS**

•

**SINCLAIR**
**REFINING COMPANY**
630 FIFTH AVENUE NEW YORK CITY

**ALEMITE PRODUCTS**
FOR
AUTOMOTIVE-INDUSTRIAL-FARM
**LUBRICATION**

- LUBRICATION FITTINGS AND HAND GUNS
- HANDLING AND TRANSFERRING EQUIPMENT
- POWER OPERATED LUBRICATION EQUIPMENT
- PORTABLE LUBRICATION DEPARTMENTS
- AUTOMATIC LUBRICATION SYSTEMS
- CENTRALIZED LUBRICATION SYSTEMS

**ALEMITE**
*division of*
**STEWART-WARNER CORP.**
CHICAGO

# DESIGN OF ANTI-FRICTION BEARING INSTALLATIONS WITH SPECIAL REFERENCE TO ELECTRIC MOTORS

Continued from March, 1947 Issue

Actual grease replacement within the bearing proper of a motor equipped for regreasing is obtained by using an unshielded or single shielded bearing and directing the flow of the added grease at the side of the bearing so as to displace some of the old grease. Provision should then be made for removal of excess displaced grease. A simple method is to provide grease drains that are open only during the time the grease is added and for a definite period a simple pipe plug that is removed when the operator adds grease to the bearing. It should be noted that it is frequently necessary to manually break up caked grease within this opening to insure relatively free flowage. This may be supplemented frequently by removal of the grease fitting for the same period of time after the grease is added. The machine, of course, should be operated during the time the escape fittings are removed, and, preferably, should be in operation during the time the grease is added. The drain should be large and of short travel; however, in certain types of motors, for instance, totally enclosed fan-cooled motors or those having an exciter or other piece of equipment overhanging on one end, such a drain connection often must be of considerable length (Figure 3). If the drain is rather long, it is very important that the operator take extreme care that all excess grease is forced out. The grease inlet on such designs should be near the raceways so that fresh grease will be sure to work throughout the bearing, and the drain should be in position to readily conduct the excess used grease from the chamber. It may or may not be on the same side of the bearing as the inlet. The efficiency of purging or flushing is, of course, raised considerably by adding sufficient grease on some occasions to cause some of the newly added grease, in turn, to be forced out of the chamber.

A safer procedure may be to provide grease escape fittings that will function at all times if possible. Pressure relief fittings can be incorporated in the grease fitting; however, these will maintain some pressure and are not considered to be too effective. For full effectiveness, such openings should be of adequate size and so located as to permit ready flow while the grease level is overly high. In a fairly clean location, this opening may take the form of a freely opening cover that will open under any pressure, allowing the excess grease to fall clear of the machine, or the openings may be into sumps within the housing. Such a sump, of course, must be easily accessible for inspection and emptying when required. These self-acting drains must, as we have mentioned, be large and of very short travel to prevent caking grease from obstructing the drain passage.

The addition of a grease removal arrangement to the same shielded or baffled and sectionalized cavity arrangement mentioned previously, to provide for complete displacement of excess grease with consequent prolongation of time intervals between shutdowns, is beneficial. This arrangement may again take the form of a sump, although space is usually not available, or a fitting which can be opened to the outside.

Fluid flushing or washing is not commonly used for cleaning of grease lubricated bearings and housings without dismantling. This type of flushing must be done very thoroughly or foreign materials may be actually moved into the bearing proper through the flushing medium. Care must also be exercised in the selection of the flushing medium, as several otherwise

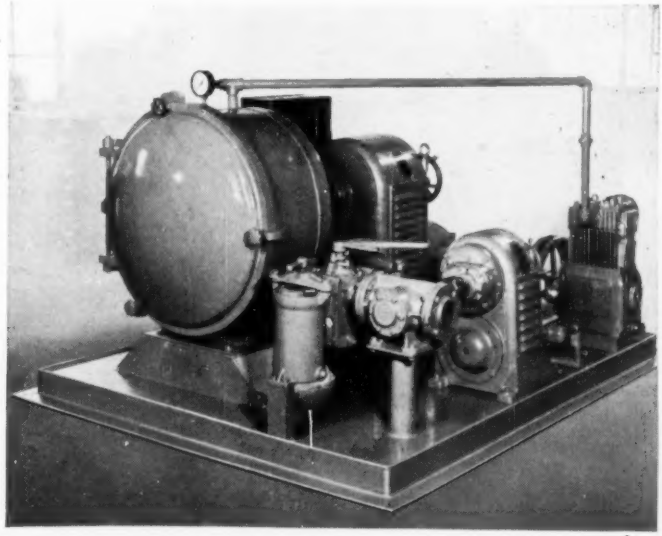
Continued on following page


## America's Finest Greases are processed by this machine

**The nation's leading grease manufacturers are processing with the Cornell Machine because of its exclusive micro-film method, which reduces even the heaviest greases to an extremely thin film moving over a rotating disc with great velocity and tremendous turbulence. The result is a supremely smooth, thoroughly worked product which is completely de-aerated. The processing is done at a rate up to 210 pounds per minute.**

***Write for details of installation***

THE CORNELL MACHINE COMPANY
101 PARK AVENUE, NEW YORK 17, N. Y.



*Grease Homogenizer, showing feed pumps, strainers and vacuum pump.*

## THE CORNELL MACHINE
For Processing
Lubricating Oils and Greases

suitable fluids sometimes have a tendency to promote rusting of the highly polished surfaces. Fluid flushing is, of course, not practical from the shielded side of an anti-friction bearing. The length of time between flushing periods must not be so great that the grease has an opportunity to become excessively hardened.

Solidification of the grease can proceed to a point where the difficulty of softening and washing out the hardened mixture is considerably greater than would be required if intervals between flushing were not so great.

Bearings contained in housings, split horizontally, are effectively washed by removing the upper half to scrape out all old grease, adding the solvent or flushing oil to the lower level of the shaft seal and replacing the upper half. Slow rotation will then work out the remaining grease from within the bearing. Draining out the solvent of flushing oil and removing the upper half of the housing to wipe dry all exposed parts and then reflushing with clean oil, will prepare the bearings for repacking with grease. This procedure can also be effectively followed for the cleaning of bearings accessible thru complete removal of or the backing off of an outside end cap or shaft seal. We feel that it is not advisable to wash, in this manner, bearings within an unopened closure because there is no definite assurance in such cases that all of the undesirable material is being removed.

*Conclusion*

The maximum practical consideration should always be given in any design of an anti-friction bearing assembly to definitely prevent the possibility of overgreasing.

Units that will run safely for long periods without any maintenance are most fully protected by elimination of any greasing provision. Bearings for service that is severe enough to require some lubricant makeup or supplementary grease sealings are best protected by internally safeguarding the bearing. Properly detailed design can insure that the fresh grease intermingles with the old grease to force some of the old grease from the vicinity of the bearing. The most heavily loaded bearings are best serviced by minimizing the baffling and designing for the addition of grease directed toward the path of travel of the balls or rollers, and providing adeqaute grease removal facilities for used and excess lubricant.

In short, the most severe the service or loading, the greater value and necessity for periodic grease replacement with a minimum of effort. Modified grease purging is then accomplished with each injection of lubricant, and a highly effective degree of cleaning is obtainable by replacement of a proportionally larger amount of grease.

The more fool-proof designs are suitable for the smaller machines with bearings that are usually not heavily loaded. Those bearings operated under the most severe circumstances, unfortunately must be provided with the least fool-proof lubricating system. From the above statements, we can conclude that no one

*Continued on page 15*

*Manufacturers of*

QUALITY GREASES

•

Made to Your
Specifications
Under Strictest
Laboratory Control

•

AMERICAN LUBRICANTS, Inc.

1575 CLINTON ST.

BUFFALO 6, N.Y.

HARDESTY

Fats & Fatty Acids
For the
Grease Manufacturer

W. C. HARDESTY CO., Inc.
NEW YORK, N. Y.

Now Available in
3 MOLECULAR WEIGHTS

PETRONATE
(Reg. U. S. Pat. Off.)

PETRONATE is a purified, highly concentrated petroleum sulfonate—free of all impurities—absolutely uniform in all essential properties. Write Dept. IS for sample, indicating molecular weight desired and use intended.

Molecular weight

| PETRONATE H | PETRONATE | PETRONATE L |
|---|---|---|
| 500/525 | 440/470 | 415/430 |

WHITE OIL AND PETROLATUM DIVISION
L. SONNEBORN SONS, INC.
88 Lexington Avenue, New York 16, N.Y.
Refineries: Petrolia and Franklin, Pa. Branch offices: Chicago, Baltimore, Philadelphia, Los Angeles. Stocks carried in principal cities.
In the Southwest: Sonneborn Bros., Dallas 1, Texas

DEALERS "RATE"
THIS SIGN AS A
Super Salesman

QUAKER STATE
OIL REFINING CORP.
OIL CITY, PENNA.
Member of Pennsylvania Grade Crude Oil Association, Permit No. 50

FISKE BROTHERS
REFINING CO.

Established 1870

★

NEWARK, N. J.
TOLEDO, OHIO

★

Manufacturers of

LUBRICATING
GREASES

## More New Advertisers

"The Spokesman" welcomes an opportunity to call its reader's attention to the new advertisers that are using the columns of "The Institute Spokesman" to carry their sales message. There is justified pride and pleasure in watching this growing list of companies who recognize "The Spokesman" as a good advertising medium. These firms are worthy of the recognition we are according them here. Along with it goes our sincere thanks for the advertising they have scheduled.

Last month the special Tenth Anniversary March issue hit an all time high in "Spokesman advertising. Many companies were there for the first time and we are delighted to have them continue in each issue for the rest of 1947. Others have agreed to an intermittent schedule. To all of them a cordial and genuine welcome!

The Stratford Engineering Corporation of Kansas City, Missouri used the back page for a two color ad and have agreed to use that same space for the remaining issues published during 1947.

The Sinclair Refining Company whose Mr. Howard Cooper serves on the N. L. G. I. Board of Directors has a sixth page ad as does American Lubricants, Inc. at Buffalo.

The W. C. Hardesty Company, Inc. of New York, regularly users of a one-twelfth page space doubled their space three times over to use a half page while the Votator Division of the Girdler Corporation at Louisville was back with a full page for the second time this year and the third time since November when we changed "The Spokesman" format.

When this list is combined with those new advertisers who were mentioned on page seven of the February, 1947, issue of "The Institute Spokesman" it makes a sizeable group.

In bidding these newcomers welcome we are not unmindful of the "old timers" whose advertsing message has been a part of every issue of "The Institute Spokesman" for a long, long time. To these "regulars" we pay our tribute and call our readers' attention.

*A Complete* GULF *Line of . . .*

QUALITY OILS AND GREASES

★

GULF OIL CORPORATION—GULF REFINING COMPANY

DIVISION SALES OFFICES
Boston—New York—Philadelphia
Pittsburgh—Atlanta—New Orleans
Houston—Louisville—Toledo

REFINERIES
New York, N. Y.—Philadelphia, Pa.
Pittsburgh, Pa.—Toledo, O.—Cincinnati, O.
Port Arthur, Tex.—Fort Worth, Tex.
Sweetwater, Tex.

## Thanks for Your Congratulations

Many firms used advertising space in the special Tenth Anniversary March issue of "The Institute Spokesman" to send their congratulations to "The Spokesman" on its tenth anniversary. In some cases the regular scheduled amount of advertising space was used. In other cases the space was increased to accommodate their congratulatory message and in other cases they were "newcomers," new names and faces. To all of them we express our appreciation and want to extend our thanks in having helped in such a material and complimentary way to make the tenth birthday issue such a big success.

Using their regular allotment for advertising space, a half page, for congratulatory purposes was President H. P. Hobart's Gulf Oil Corporation.

Among the "newcomers" using a half page to extend their greeting was the Pure Oil Company of Chicago, whose Mr. W. G. Clark serves on the N. L. G. I. Board of Directors, the Lubri-Zol Corporation of Cleveland and the H. K. Stahl Company of St. Paul.

Increasing their usual advertising space from the regular one-sixth page to a full half page for their greeting was Fiske Brothers Ref. Company of Newark whose Mr. G. E. Merkle serves on the N. L. G. I. Board, Socony Vacuum Oil Company whose Mr. B. C. Voshell in addition to his Board duties is Chairman of the N. L. G. I. Executive Committee and Swan Finch Oil Corporation whose Mr. E. V. Moncrieff serves on the Board and also as the N. L. G. I. Treasurer.

Using one-third page and for the first time is the Southwest Grease and Oil Company of Wichita whose Mr. H. A. Mayor is on the N. L. G. I. Board.

Emery Industries, Inc., doubled their one-twelfth page ad and the Warren Refining and Chemical Company of Cleveland used one-twelfth page as did Penola, Inc. in addition to their regular one-third page space.

EMERY

Animal, Cottonseed, Hydrogenated Fish Oil FATTY ACIDS, STEARIC and OLEIC ACIDS for compounding Greases and special Lubricants.

EMERY INDUSTRIES, INC.
Cincinnati 2, Ohio

Penn-Drake

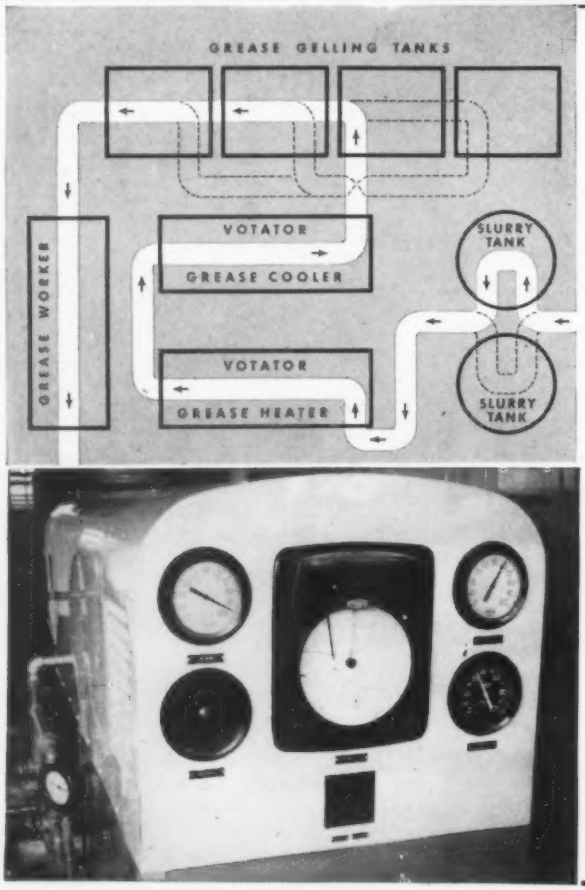
PETROSULS

Petroleum Sulfonates

The high quality and dependable uniformity of Penn-Drake PETROSULS insure complete satisfaction to the user of these modern products. Write for full information and specifications.

PENNSYLVANIA
REFINING COMPANY

General Offices: BUTLER, PA.
Branches: Cleveland, Ohio; Edgewater, N. J.
Representatives in Principal Cities




Votator

CONTINUOUS, CLOSED GREASE PROCESSES

In addition to a production proved process for the manufacture of a uniformly high quality aluminum stearate grease, the VOTATOR division of The Girdler Corporation is now in a position to offer an efficient system for manufacturing the widely used calcium and sodium base lubricating greases. Let us send you more specific information in terms of your production requirements. Write for data form V-19. The Girdler Corporation, Votator Division, Louisville 1, Kentucky.

DISTRICT OFFICES: 150 Broadway, New York City 7; 2612 Russ Bldg., San Francisco 4; 617 Johnston Bldg., Charlotte 2, N. C.

Typical flow diagram of continuous, closed VOTATOR process, for aluminum stearate grease, and closeup of VOTATOR grease heater.

VOTATOR is a trade mark (Reg. U. S. Pat. Off.) applying only to products of The Girdler Corp.

Specialized Glycerides
and
FATTY ACIDS
for
Lubricating Greases
•
THE
WERNER G. SMITH CO.
(Division of Archer-Daniels-Midland Company)
2191 West 110th St., Cleveland, O.

STEEL DRUMS—PAILS
—for oil, grease, and other petroleum products
Made with a wide variety of spout openings and head designs including the E-Z seal lever locking ring cover. Special tested linings provided for high test aviation gasoline and many other sensitive products.

3 to 55 Gal.
INLAND STEEL CONTAINER CO.
CONTAINER SPECIALISTS
6532 S. Menard Ave., Chicago 38, Ill.

## Design of Anti-Friction Bearing Installations

Continued from page 12

basis for design of grease lubrication should be universally applied to electric motors.

To provide the purchaser and operator with an opportunity to obtain the fullest possible benefits of any design, simple but adequate instructions must be attached to every motor prior to shipment from the factory; however, the final successful operation will depend on the good judgment of the operator in carrying out these instructions.

*Presented by W. T. Saveland, Allis-Chalmers Manufacturing Company, at the annual meeting of the N. L. G. I., Chicago, Illinois, Sept. 30 to Oct. 2, 1946.*

STEEL SHIPPING CONTAINERS
STEEL PAILS AND CANS
All Sizes—All Styles
*We would appreciate your inquiries*
Central Can Company, Inc.
2415 W. 19th STREET
CHICAGO, ILL.

**Bibliography**

"A Program for Industrial Lubrication"
V. M. Palmer and C. L. Pope, Mechanical Engineering, Vol. 62, No. 12, Dec., 1940.

Comments on "A Program for Industrial Lubrication"
Mechanical Engineering, Vol. 63, No. 9, Sept., 1941.

"Lubrication Progress Paces Ball and Roller Bearing Developments"
Lubrication, Vol. 31, No. 2, Feb., 1945, The Texas Co.

"Attention-Free Bearings that Require No Lubrication"
Electrical Manufacturing, Vol. 33, No. 6, June, 1944.

"Lubrication of Industrial and Marine Machinery"
W. G. Forbes, Wiley, New York, 1943.

"SKF Engineering Data Sheets"
SKF Industries, Philadelphia, 1938.

"SKF, A Guide to Better Bearing Lubrication"
SKF Industries, Philadelphia, 1942.

"New Departure Engineering Service, Part One, Bearing Application"
New Departure Div., General Motors Corp., Bristol, Conn.

"New Departure Handbook"
New Departure Div., General Motors Corp., Bristol, Conn., 1942.

"Fafnir Engineering Manual No. 35"
Fafnir Bearing Co., New Britain, Conn., 1944.

"Ball Bearing Practices for the Shop Man"
Bull. No. 17, "Grease Lubrication of Ball Bearings"
Marlin-Rockwell Corp., Jamestown, N. J.

"Lubricants and Lubrication Systems"
Chapter 45—Bureau of Ships Manual
U. S. Navy, Bureau of Ships
Govt. Printing Office, Washington, 1944

"Instructions for the Operation and Maintenance of Bearings and Shafting"
Chapter 43—Bureau of Ships Manual
U. S. Navy, Bureau of Ships
Govt. Printing Office, Washington, 1943

"Ball and Roller Bearing Lubrication"
The Texas Company, New York, 1944.

"Lubrication and Maintenance of Ball and Roller Bearings"
Bulletin No. 506A—New York and New Jersey Lubricant Co., New York.

"The Lubriplate Film Lubrication of Ball and Roller Bearings"
Fiske Bros. Refining Co., Newark, N. J.

*Producers of*
LEAD NAPHTHENATE
MOONEY CHEMICALS, INC.
INDUSTRIAL CHEMICALS
Phone
Prospect 2867
2394 CANAL ROAD
CLEVELAND 13, OHIO

STRATCO

# PRESSURE SOAP CONTACTORS
and
# HOT OIL CIRCULATION HEATING SYSTEMS
*Will Modernize Your Grease Making Technique*

*And Provide*

- **Extremely Short Manufacturing Time Cycles**
- **Greatly Reduced Fat Consumption**
- **Precision Grease Manufacture**

# STRATFORD ENGINEERING
CORPORATION
PETROLEUM REFINING ENGINEERS
DIERKS BLDG. KANSAS CITY, MO.